Sustainable nutrition in company and educational facilities as well as prisons

Nutritional and ecological improvements of catering services

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Online-Supplement

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Nutritional and ecological improvements of catering services

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Selection of the participating companies

The selection of the participating kitchens was carried out by the Hessian Ministry for the Environment, Climate Protection, Agriculture and Consumer Protection (HMECAC), which, with regard to the selection of the prisons obtained the consent of the Hessian Ministry of Justice. In selecting the companies, the following criteria were considered.

- Catering of healthy adults: All participating facilities should primarily work in the field of adult catering. Specific population groups (sick, elderly, pregnant/ nursing women, etc.), for which specific nutritional recommendations apply, were not in focus.
- Spatial focus: all participating companies should be located in Hesse.
- CC segments: according to the HMECAC company restaurants, educational institutions and prisons should be included.

Prisons: The facilities were selected because, to our knowledge, no comparable studies have been carried out in prisons to date. The three participating prisons are a women's prison, a men's prison and a juvenile detention center.
Company restaurants: In the case of company restaurants managed by private catering companies, care was taken to ensure that different target groups – office staff and physical workers – were included. Among the catering companies, preference was given to companies that manage several company restaurants

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throughout Germany or worldwide, in order to enable easy multiplication of the results.
Educational institution: Also, in case of the participating educational institution preference was given to companies that manage several facilities throughout Germany in order to enable easy multiplication of the results.
Further information on the selection of the participating facilities can be found in the final reports of the project [1].

Waste analysis tool from United Against Waste (UAW)

Method of measuring food waste in four sections

All food waste generated is collected daily in the kitchen and sorted into four transparent collection containers. The four collecting containers represent the following kitchen process: (i) waste from storage by expiration of the best before date, (ii) production waste during processing (peeling of carrots, etc.), (iii) overproduction and (iv) plate return. The waste volumes of the four containers are separately weighed daily and corresponding quantities documented. Subsequently, the daily results and the number of produced dishes are transferred to the online-based waste analysis tool [2]. Although coffee and tea residues as well as oil waste (grease traps) are collected separately within the waste analysis tool of UAW, these were not included in this project because the avoidable waste was in the focus.

Online based-waste analysis tool

The kitchen staff enter their measurement results into the online-based waste analysis tool on a daily basis. The data entered is used to visualize changes and thus the success and failure of implemented measures in diagrams (◆ Figure 1).
Hence, employees can easily see where food waste is generated in the kitchen process. Various measures – such as a changed offer (including various portion sizes, improved management of the buffet and serving) – can thus be directly implemented and make a significant contribution to waste prevention.
On the basis of the measurements carried out so far with the waste analysis tool, UAW was able to develop valid key figures and average values in the area of food waste for out-of-home catering [2].

Average composition of food waste

As the individual components could not be analyzed separately when measuring the food waste, the calculation of the environmental impacts of the waste is based on a defined composition of a standard waste. The percentage values of this standardized composition were generated on the basis of more than 250 measurement results from company restaurants (n = 269), as well as the exchange of experience with company and kitchen managers [2]. The exact composition of this standard waste by components is shown in ◆ Figure 2.

Combining the waste analysis tool and the accounting and optimisation tool susDISH

To determine the environmental impacts of the food waste, component-specific environmental indicators were integrated into the waste analysis tool (◆ Table 1).

Life cycle assessment (LCA) approach and system boundaries

In accordance with the ISO standard 14040/44 (2006), life cycle inventory data were calculated by attributive modeling and mass allocation [3]. The system boundaries were defined in the project from cradle-to-fork, i. e. all environmental impacts along the food chain from the primary agricultural production and processing to the use of the products in the canteen kitchens including transport, packaging and preparation were considered. Credits or additional environmental burdens from the recycling of food and packaging waste (in biogas or waste incineration plants) were not included.

Carbon footprint

The accounting of the carbon footprint (greenhouse gas emissions) is based on the ISO standard 14067 (2013) [4] and IPCC (2006) [5]. The following characterization factors (CH_4 = 25, N_2O = 298) were used to calculate the greenhouse gas potential in CO_2-equivalents (CO_{2e})

Water footprint

The accounting of the water footprint is based on the ISO standard 14046 (2014) [6]. Accordingly, only blue water is balanced. This includes water used in agriculture, food industry and gastronomy, which is used via channels and pipelines for watering animals, for irrigating vegetables in greenhouses and in open-fields, for cleaning in the food industry or for cooking, etc. Green water (direct precipitation) and grey water (sewage) are not considered in the method.

Land footprint

The accounting of the land footprint is based on statistically recorded yields (t/ha), which were converted into corresponding area factors (m^2/kg) [7]. A distinction is made between several types of land (arable land conventional/organic, grassland/conventional/organic, permanent crops/conventional/organic, forest area).

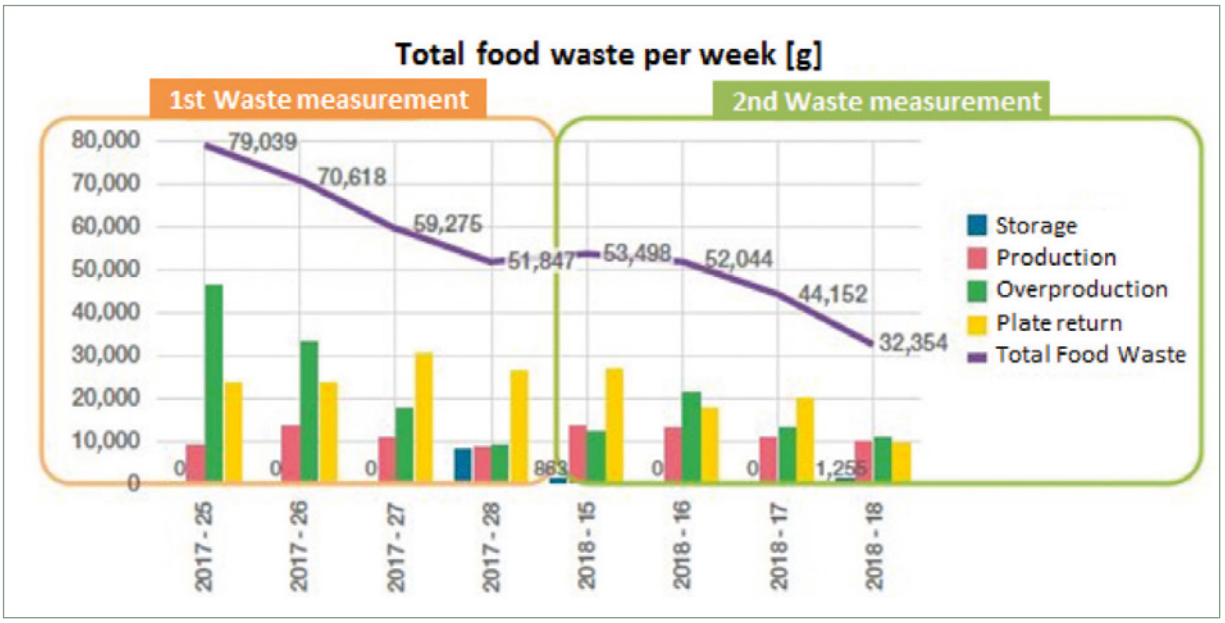

Fig. 1: **Example for the presentation of the measurement results in the waste analysis tool** [1]

Overall environmental indicator: Environmental impact points (eco-points)

The method of ecological scarcity used here takes into account 15 different environmental indicators (emissions of CO_2, CH_4, N_2O, NH_3, NO, NMVOC, SO_2, H_2S, HCl, N-surplus, P- surplus, demand of blue water, use of pesticides, primary energy demand, land use), which are evaluated with regard to the impact indicators greenhouse gas effect, air pollution, acidification, eutrophication, human- and eco-toxicity, cumulative energy demand (CED) as well as biodiversity loss. Since 15 different environmental impacts cannot be communicated in a practicable way, these are weighted using the method of the ecological scarcity [8].

To this end, indicator-specific environmental impact points (eco-points) were derived on the basis of official material flows (reference year 2010) and corresponding political targets in Germany. Hence, the method can be used to compare different environmental impacts with each other and thus make them calculable. The carbon, water and land footprint are part of the overall indicator.

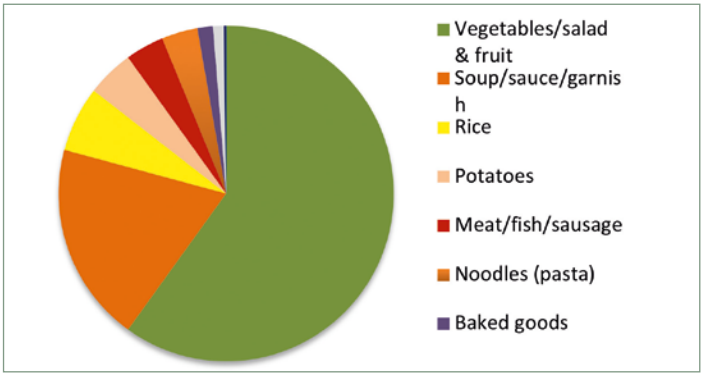

Fig. 2: **Composition of standard waste for the company catering sector** [2]

Example recipes

Example recipe 1: chicken fricassee with rice (◆ Table 2)

With 809 kcal and 20 g fat (optimum: 28–32 g), the dish was evaluated in the baseline survey as energetically balanced but low in fat. In addition, only low levels of vitamin B_1, vitamin C, calcium and iron were present. By reducing the meat from 135 g to 120 g, the environmental impact (from 88 to 82 Eco-points) was slightly reduced. By supplementing the recipe with green peas the vitamin B_1 content and the fiber content could be increased. The addition of lemon concentrate increased the vitamin C content and the absorption of the iron contained in meat and green peas.

However, motivated by a recommendation for a different recipe, the kitchen used bulgur in the recipe instead of rice, whose cultivation is associated with high water consumption and high greenhouse gas emissions, and was thus able to further reduce the Eco-points to 70 and the carbon footprint to 0.9 kg CO_{2e}.

Example recipe 2: beef goulash with croquettes and broccoli (◆ Table 3)

The recipe beef goulash with croquettes and broccoli (◆ Table 3) is characterized by a high protein content of 53 g (optimum: 30–38 g). Due to the beef content of 180 g, this recipe in its baseline survey has the highest Eco-points, carbon footprint and the highest land footprint of all recipes examined in this ki-

Components[a] of the standard waste in the company catering [2]	Carbon footprint Greenhouse gas emissions (kg CO_{2e}/kg)	Water footprint Water use (l/kg)	Land footprint Area (m^2/kg)	Environmental impact points Eco-points/kg	Notes
Vegetables/ salad and fruit	1.56	111.95	0.49	58.47	Consisting of 50% of vegetables-EU (prepared and fresh) and 50% fruit-EU
Soup/sauce/ garnish	2.04	23.94	1.05	80.22	Consisting of 66% water, 19% vegetables-EU, 11% meat mix-DE, 3% oil mix, 1% salt
Rice	3.75	541.44	3.36	194.59	Origin: 50% from Thailand, 50% from Italy
Potatoes	1.64	16.53	0.33	32.39	Potato fresh, cooked
Meat/fish/ sausage	9.64	50.08	9.54	593.19	Consisting of 40% of pork-DE, 20% poultry, 20% beef, 20% fish
Noodles (pasta)	2.28	19.52	1.66	100.36	Based of durum wheat
Baked goods	1.92	14.62	1.66	96.81	Based of wheat
Dessert	2.63	20.57	1.89	120.47	Consisting of 79% milk, 18% sugar, 3% starch
Eggs/cheese	5.66	31.02	6.76	412.66	Consisting of 50% eggs, 50% cheese

Tab. 1: **Components of the standard waste and corresponding environmental indicators**
[a] in descending order

1chen. By reducing the meat content from 180 g to 120 g, the environmental impacts were reduced from 287 to 206 Eco-points. A further reduction (from 206 to 80 Eco-points) was achieved by the kitchen by using poultry instead of beef. The reduction of the meat content also lowered the purchase price of the components. The kitchen invested this economic saving for the purchase of broccoli from organic farming.

	HP	Eco-Points	Carbon footprint [kg CO_{2e}]	Water footprint [L]	Land footprint [m^2]
BASELINE	9.7	88	1.1	77.3	1.3
Recommendations: • reduce poultry meat from 135 g to 120 g • add 15 g pulses (e. g. green peas) to the recipe • add 3 g lemon concentrate					
TARGET	10.2	82	1.1	77.0	1.2
Implementation by the kitchen: • meat component reduced from 135 g to 120 g • recipe supplemented with 15 g green peas • 3 g lemon concentrate added • use of bulgur instead of rice					
FINAL	12.0	70	0.9	8.4	1.1

Tab. 2: **Chicken fricassee with rice**
(the numbers presented are referred to one portion; total planned portions: 850)

Example recipe 3: vegetable stew with bread roll, apple (◆ Table 4)

The dish was evaluated as low in protein (optimum: 30–38 g) with 20 g protein in the baseline survey. Increasing the proportion of legumes to 60 g, increases the protein and fiber content. With only 4 g fat, the recipe was also rated as very low in fat (optimum: 28–32 g). By adding 20 g rapeseed oil, the amount of fat in one portion was increased to 24 g. With 21 g (2.5 g/100 g vegetable stew) of salt, the recipe was classified as too salty in the baseline. A gradual reduction of the salt content was recommended in order to maintain the taste acceptance by the guest.

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	HP	Eco-Points	Carbon footprint [kg CO_{2e}]	Water footprint [L]	Land footprint [m^2]
BASELINE	13.1	287	5.0	33.4	5.2
Recommendations: • reduce beef component from 180 g to 120 g • enrich goulash with maize and legumes (e.g. runner beans, lima beans or kidney beans)					
TARGET	13.0	206	3.7	26.9	3.6
Implementation by the kitchen: • meat content reduced from 180 g to 120 g • beef replaced by poultry-meat • use of organically grown broccoli					
END	13.6	80	1.3	14.7	1.1

Tab. 3: **Beef goulash with croquettes and broccoli**
(the numbers presented are referred to one portion; total planned portions: 850)

	HP	Eco-Points	Carbon footprint [kg CO_{2e}]	Water footprint [L]	Land footprint [m^2]
BASELINE	9.3	36	0.5	63.4	0.4
Recommendations: • increase the amount of fat by 20 g (e. g.: by adding 20 g of vegetable margarine or 20 g rapeseed oil) • increase the green pea and bean content to 30 g each • gradual reduction of the salt content					
TARGET	10.2	40	0.6	68.4	0.5
Implementation by the kitchen: • addition of 20 g rapeseed oil • increase the green pea and bean content to 30 g each • gradual reduction of the salt content					
FINAL	10.3	38	0.6	64.4	0.4

Tab. 4: **Vegetable stew with bread roll, apple**
(the numbers presented are referred to one portion; total planned portions: 240)